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AIC-193
July, 1948

UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Agricultural and Industrial Chemistry
Agricultural Chemical Research Division
2100 Robert E. Lee Boulevard
New Orleans, Louisiana

REPORT OF STUDIES ON THE UNIFORMITY OF QUALITY OF BEET SUGARS, NO. XXVII. Pt I-II

I. Chemical and Physical Studies on the Beet Sugars of the 1947 Campaign, by C. A. Fort and S. Byall.

II. Biological Studies of the 1947 Beet Sugars, by H. H. Hall and Dorothea J. Teunisson.

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REPORT NUMBER XXVII

A Review of the Operating Data of the 1947 Campaign and of the Chemical, Physical, and Biological Studies on the Sugars Produced.

PREFACE

Seventy-three of the domestic beet sugar factories operated during the 1947 campaign. Individually the beets processed ranged from 15,000 to 626,730 tons for an average of 164,270 tons per factory. The Steffen process was used at 29 of the factories and 1 factory used the ion-exchange purification for nearly the entire campaign. Another factory used the ion-exchange process for partial demineralization and a third used the complete process for a small part of the campaign.

All except one of the factories submitted composite samples for analytical examination. Eleven additional sugars were included in the studies, of which only four (numbers 4702B, 4706B, 4744B and 4756B) were included in calculating the general means.

In Part I are presented, first, a tabular summary, with brief discussion, of the operating data supplied by the sugar factories, and, second, the chemical and physical data obtained on the composite sugars. In Part II are summarized the biological data on the composite sugars.

The excellent cooperation of the factories in supplying the operational data and the sugar samples is a very essential part in making this report possible.

PART I

OPERATING DATA FOR THE 1947 CAMPAIGN AND CHEMICAL AND PHYSICAL STUDIES OF THE SUGARS PRODUCED

By C. A. Fort and S. Byall

A. Factory Operating Data

(1) Quality of beets and diffusion juices (Table 1). The general average for sugar content in beets was 15.68% as compared with an average of 15.79% in the 1946 campaign. This is the lowest value since 1942 when a content of 15.40% was averaged. Diffusion juice purity remained at 86.4%, the same value shown for the 1946 campaign. Only a slight change from 1946 was found in the apparent nonsugars in diffusion juice as percent on beets.

(2) Liming and Carbonation (Table 1). The lime used at non-Steffen factories was less than for several years but is the same as the past 10-year average. The use of soda ash at non-Steffen factories showed no change; but Steffen factories used an increased amount, as compared with 1946. The pH after second carbonation ranged from 8.3 to 9.7 and alkalinities from 0.007 to 0.024.

(3) Sulphuring (Table 2). The average amount of sulphur used per ton of beets was the lowest for any year. As will be seen later, this produced low sulphites in sugars but not the lowest. One factory has operated without the use of sulphuring for the past two seasons, with a satisfactory effect except for lowering of sugar quality in respect to reflectance and color and turbidity in solution.

(4) Standard Liquor (Table 2). While the density at which standard liquors were filtered ranged from 52° to 73° Brix, the range, except for five instances, was within 60° to 70°, with a general average of 66°. The filter-aid used averaged slightly higher than in 1946 attaining the highest value to date for the non-Steffen factories, and the next to highest for the Steffen factories.

The purities of the standard liquors averaged about 0.5% above 1946 values.

In the last report (page 8) a scheme was suggested for expressing the lime salt characteristics as the sum of the soda ash used plus the lime salt content. Since lime salts reached average values above any recent year in spite of the use of a high average amount of soda ash, the lime salt rating increased sharply over other years for both non-Steffen and Steffen operations. For non-Steffen factories the lime salt rating in 1948 was 92 as compared with 83 for last year while the corresponding Steffen rating was 140 as contrasted with 116. According to Swedish workers, the lime salts do not necessarily affect sugar recovery or sugar quality but have their greatest significance as indicators of the amount of breakdown of sugars during processing. Lime salts are partly the result of nonsugar characteristics of the diffusion juice and partly of the destruction of reducing sugars. It may be thought that the recent trend to higher lime salts is due to processing juices of higher than normal content of reducing sugars; but this cannot be concluded until more information is available on the reducing sugar content of diffusion juices. It would be desirable to include this determination in the routine control testing, which could be accomplished by compositing aliquots of the regular leaded filtrates prepared for polarization of cossettes or diffusion juice. The testing of only 12- or 24-hour composites would reduce the number of determinations so that they could be handled by the special chemist. An unpublished modified Eynon-Lane titration method for estimation of the relatively low concentrations of reducing sugars commonly present in sugar beets can be obtained on request from the Agricultural Chemical Research Division.

TABLE 1

BEET END PROCESS DATA

(A) Non-Steffen Operations

Key No.	Beets		Juice		Lime Used % Beets	Soda Lbs. Per Ton	Carbonation Alkalinity		
	Polarization	Purity	Brix	Purity			1st Carb.	2nd Carb. Alk.	2nd Carb. pH
4703	15.42	--	11.8	87.1	1.53	0.26	0.074	--	9.4
4704	16.04	83.6	11.0	85.5	3.29	0.32	*11.0	--	9.45
4705	15.51	84.2	11.7	87.2	1.85	0.05	0.074	0.019	9.2
4706A	17.52	83.4	15.7	85.3	2.98	0.0	0.080	0.017	--
4706B	16.97	85.1	15.6	86.9	2.54	0.0	0.080	0.017	--
4708	16.57	88.1	13.3	88.4	2.10	0.12	0.076	--	9.1
4709	14.80	80.4	11.6	83.8	3.69	0.36	0.079	0.007	--
4710	15.68	88.1	11.1	88.1	1.15	0.27	0.073	--	9.3
4711	14.84	86.2	11.9	86.2	1.47	0.34	0.082	--	9.4
4712	16.29	86.9	11.3	90.1	--	0.55	0.063	0.019	9.2
4713	15.34	86.1	11.4	87.9	1.92	0.62	0.076	0.016	--
4714	15.63	84.9	14.2	87.0	1.90	0.05	0.085	0.019	9.1
4715	15.29	83.1	13.8	83.6	2.33	0.29	0.080	0.020	8.9
4716	16.79	82.9	14.1	85.2	1.83	0.0	0.086	0.018	8.9
4717	15.93	86.6	14.4	86.6	2.74	0.40	0.075	0.024	9.0
4721	14.69	85.9	13.0	85.3	2.32	0.11	0.083	0.024	9.1
4722	15.28	87.3	11.0	87.3	1.32	0.56	0.077	--	9.4
4725	15.12	87.8	10.9	87.8	1.15	0.50	0.068	--	9.4
4727	14.43	76.4	10.2	84.0	3.63	1.02	0.075	--	9.0
4732	15.08	88.0	10.7	88.0	1.22	--	0.082	--	9.2
4733	15.22	84.4	12.1	84.4	2.53	0.0	0.071	0.022	--
4734	15.74	84.1	13.0	84.8	2.41	1.07	0.082	--	9.0
4735	16.38	85.5	12.6	85.8	1.81	0.46	0.071	0.014	9.1
4739	15.64	87.0	12.2	88.1	1.71	0.0	0.081	--	8.4
4743	17.24	88.8	12.2	88.8	1.39	0.05	*10.9	--	9.3
4744	15.07	86.0	12.1	86.0	1.70	0.01	0.078	--	9.5
4745	15.48	83.9	11.4	85.6	2.62	0.0	0.091	0.019	[illegible]
4747	15.42	82.0	12.2	83.9	2.7	0.0	0.066	0.015	--
4749	16.44	89.3	12.7	89.6	2.20	0.0	0.073	0.024	9.6
4750	15.98	88.3	11.6	88.3	1.48	0.16	0.075	--	9.4
4751	13.64	80.9	11.9	80.7	2.42	0.33	0.085	--	8.8
4752	15.30	82.9	11.6	86.3	2.52	--	*11.1	--	8.9
4754	15.94	85.1	14.2	88.2	1.80	0.45	0.056	0.020	--
4755	14.92	--	11.4	82.9	3.25	0.75	0.062	0.018	--
4758	15.58	81.4	12.9	84.2	3.36	0.0	0.045	0.021	--
4759	16.35	86.9	12.2	88.6	2.55	0.0	0.082	--	9.3
4761	16.37	86.4	13.7	89.8	2.11	0.41	0.066	0.024	9.4
4762	14.63	84.3	10.7	85.8	2.91	0.48	0.079	0.019	--
4763	14.70	81.0	9.5	84.4	3.57	0.94	*11.3	--	9.6
4766	16.02	87.9	11.4	87.5	1.76	1.06	0.068	0.023	--
4769	16.41	84.6	13.1	84.5	2.11	0.23	0.078	--	9.3
4773	15.67	86.3	12.0	87.8	2.01	0.03	0.081	--	9.2
4776	14.80	87.2	14.1	87.8	2.25	0.40	0.085	0.013	--

TABLE 1 - Continued

Key No.	Beets		Juice		Lime Used % Beets	Soda Lbs. Per Ton	Carbonation Alkalinity		
	Polarization	Purity	Brix	Purity			1st Carb.	2nd Carb. Alk.	2nd Carb. pH
4780	14.94	84.3	13.3	84.6	1.64	0.0	0.074	0.016	--
4782	15.22	--	11.0	87.4	1.27	0.47	*11.3	--	9.3
4791	15.65	85.0	12.6	86.4	2.59	0.0	0.095	0.019	--
4793	15.71	83.4	13.4	84.7	3.15	0.0	*11.1	--	9.1
4794	16.88	82.1	11.9	87.7	2.46	0.03	0.072	0.012	--
(B) Steffen Operations									
4702A	18.08	85.3	12.4	84.9	4.35	1.24	0.058	--	9.0
4702B	17.41	86.0	12.5	86.3	4.45	0.79	0.065	--	9.0
4707	17.06	87.8	11.5	87.8	2.60	0.80	0.068	--	9.4
4720	16.08	86.8	12.2	88.3	2.87	0.08	0.076	--	9.3
4724	15.34	88.0	10.4	88.0	3.52	0.65	0.074	--	9.3
4726	14.62	--	13.2	86.0	3.22	1.75	0.063	--	9.3
4728	14.77	81.0	12.5	83.2	7.36	0.10	0.054	--	8.3
4729	15.89	84.9	12.1	87.3	4.22	0.28	0.070	0.012	--
4730	14.50	85.6	10.4	85.6	3.04	0.35	*11.0	--	9.2
4731	15.02	--	13.0	85.6	3.58	0.76	*10.8	--	9.3
4737	16.57	88.4	14.6	89.1	3.46	0.92	0.070	--	8.9
4740	15.70	85.1	11.1	86.7	3.46	0.89	0.061	--	9.2
4741	15.58	--	10.7	87.6	2.80	0.52	0.072	--	9.2
4742	15.35	87.4	9.9	87.4	3.30	0.67	0.070	--	9.2
4746	15.20	84.0	12.1	84.0	3.64	0.32	0.074	0.017	8.8
4753	16.10	88.2	13.6	90.7	3.03	0.59	0.066	0.017	--
4756	14.56	84.5	10.9	84.5	2.47	0.77	0.083	--	9.7
4757	15.95	85.3	13.6	86.1	4.13	2.20	0.075	--	8.9
4760	15.69	88.5	12.2	88.5	3.05	--	*11.2	--	9.2
4764	16.75	82.9	14.6	83.9	3.72	1.06	0.075	--	8.9
4765	15.35	86.1	11.1	86.1	3.00	0.50	0.069	--	9.2
4768	16.22	85.6	12.2	86.2	3.84	--	*11.0	--	9.2
4771	16.08	86.7	13.2	88.4	3.90	0.79	0.070	0.022	--
4772	14.56	85.1	10.8	85.1	3.04	0.71	0.060	--	9.4
4775	15.49	83.0	11.7	85.0	3.62	0.35	0.075	--	9.0
4777	15.75	86.5	12.4	86.8	3.91	0.0	0.086	--	9.2
4778	14.75	81.8	12.5	83.1	4.19	1.12	0.080	0.021	--
4779	16.22	86.1	13.7	88.2	2.83	1.07	0.056	0.018	--
4783	15.93	82.5	13.1	86.5	4.17	0.01	0.082	0.018	--
4784	17.04	87.2	11.4	89.3	3.12	0.01	0.085	--	9.0
4795	16.96	84.9	12.9	88.3	3.02	0.19	0.071	0.013	--
Avg.(A)	15.607	--	12.31	86.33	2.20	0.23	0.075	0.019	9.2
Avg.(B)	15.787	--	12.29	86.54	3.60	0.64	0.070	0.017	9.1

* First carbonation pH

TABLE 2

INTERMEDIATE PROCESS DATA

(A) Non-Steffen Operations

Key No.	Total Sulphur Used Lbs. Per Ton	Thin Juice pH	Thick Juice pH	Standard Liquor or Blow-up					
				Filtration Data					
				Brix	Filter Aid Lbs. Per Ton	Temp. C°	Purity	Lime Salts %	pH
4703	0.52	8.3	9.1	66.8	0.41	89	91.5	--	9.0
4704	*0.26	9.45	9.8	61.2	0.81	92	91.8	0.056	9.1
4705	0.40	8.4	9.4	67.7	0.61	96	92.4	0.032	9.4
4706A	0.25	8.4	8.4	64.5	0.63	92	92.3	0.065	8.4
4706B	0.24	8.3	7.5	62.9	0.58	92	92.7	0.076	7.5
4708	0.25	8.2	9.1	67.5	0.51	99	92.3	0.067	8.9
4709	0.0	8.6	9.6	63.7	0.54	92	90.8	0.042	9.5
4710	0.46	8.2	9.1	68.3	0.32	86	91.2	0.026	9.0
4711	0.56	8.0	8.8	66.4	0.26	90	90.8	0.040	8.8
4712	0.64	7.3	7.2	64.1	0.84	92	93.0	0.056	7.1
4713	*0.29	8.1	8.3	63.0	0.52	92	92.5	0.102	8.3
4714	0.29	8.4	9.5	66.9	0.52	95	91.5	0.058	9.4
4715	0.60	8.2	7.9	64.7	0.81	93	92.3	0.143	7.8
4716	0.35	8.2	8.8	69.3	0.39	95	92.1	0.088	8.9
4717	0.43	8.2	7.7	63.7	0.76	93	93.5	--	7.7
4721	0.58	7.9	8.2	67.3	0.64	92	91.8	0.046	7.0
4722	0.61	8.3	8.9	69.8	0.42	91	91.2	--	8.9
4725	*0.75	7.8	8.5	65.4	0.46	92	91.3	0.063	8.4
4727	*0.13	9.0	9.7	66.3	0.88	90	91.1	0.023	9.5
4732	0.53	7.4	8.6	68.5	0.57	92	91.9	--	8.6
4733	0.44	8.0	7.8	61.5	0.92	95	89.9	0.127	7.8
4734	0.28	8.5	8.4	68.6	0.63	94	93.1	0.048	8.4
4735	*0.48	8.0	8.2	64.9	0.45	95	93.7	0.032	8.0
4739	0.07	7.4	8.4	64.9	0.56	95	96.6	--	8.0
4743	0.47	8.1	9.0	69.1	0.39	90	92.3	--	8.9
4744	0.56	8.3	9.1	64.4	0.92	93	90.8	0.045	9.1
4745	0.21	8.5	8.3	66.9	0.42	90	92.2	--	--
4747	0.24	8.3	8.4	60.4	0.55	95	91.4	0.060	8.4
4749	0.66	7.7	7.8	67.7	0.79	93	93.5	0.014	7.7
4750	0.58	8.1	9.2	66.5	0.76	86	92.7	0.036	9.2
4751	0.47	8.4	8.1	65.0	0.55	94	91.0	0.141	8.0
4752	*0.18	8.9	9.5	59.3	0.70	90	91.0	0.038	8.9
4754	0.53	7.6	7.1	67.1	0.65	92	93.4	0.051	7.1
4755	0.21	8.1	8.7	67.5	0.55	90	89.0	0.102	8.4
4758	*0.17	9.1	9.5	51.9	0.40	90	90.3	0.146	8.7
4759	0.71	7.7	8.2	66.2	0.66	--	92.3	0.023	8.2
4761	0.66	7.2	7.2	66.8	1.12	92	93.8	--	7.1
4762	*0.43	8.6	8.9	60.2	0.68	93	92.8	0.051	8.6
4763	*0.23	9.6	9.7	64.8	0.90	94	90.6	0.016	9.3
4766	*0.38	9.2	9.1	65.7	0.58	93	92.4	0.048	8.6
4769	0.55	8.0	8.2	69.8	0.33	97	91.1	0.032	8.2

TABLE 2 - Continued

Key No.	Total Sulphur Used Lbs. Per Ton	Thin Juice pH	Thick Juice pH	Standard Liquor or Blow-up					
				Filtration Data					
				Brix	Filter Aid Lbs. Per Ton	Temp. C°	Purity	Lime Salts %	pH
4773	0.26	8.5	8.6	57.0	0.53	97	92.5	0.097	8.6
4776	0.32	8.8	7.9	68.4	0.46	--	92.9	0.118	7.9
4780	0.26	7.7	8.2	69.1	0.41	91	90.7	0.076	8.1
4782	0.45	8.4	9.1	73.5	0.40	90	91.6	--	9.0
4791	0.33	8.6	9.1	63.0	0.75	85	92.1	0.066	9.1
4793	*0.65	8.5	9.5	63.2	1.62	93	91.1	0.057	8.8
4794	*0.43	8.1	9.0	66.5	0.34	95	91.6	0.047	8.6
(B) Steffen Operations									
4702A	0.15	8.9	9.0	71.0	0.50	96	93.8	0.048	8.9
4702B	0.13	8.9	8.5	69.5	0.60	95	94.3	0.065	8.5
4707	0.39	8.3	8.8	69.1	0.55	94	92.1	0.037	8.8
4720	*0.41	8.3	8.5	62.9	0.40	90	92.2	0.041	7.9
4724	0.47	8.2	8.9	66.9	0.63	97'	92.3	0.057	8.7
4726	0.38	8.2	8.5	69.7	1.09	96	91.0	0.050	8.4
4728	*0.22	8.0	8.4	62.6	0.35	92	89.6	--	8.4
4729	0.30	8.4	8.5	64.6	0.50	94	92.4	0.072	8.5
4730	0.55	8.1	8.5	63.4	0.81	91	91.4	0.059	8.5
4731	0.55	8.0	7.4	67.0	0.57	92	91.7	0.106	7.6
4737	0.24	7.7	7.4	65.9	0.42	93	92.1	0.106	7.3
4740	0.62	7.3	7.0	64.6	1.02	85	92.8	0.061	7.0
4741	0.33	8.2	8.5	68.9	0.65	93	92.5	0.072	8.5
4742	0.43	7.7	8.6	69.0	0.61	99	92.5	0.047	8.5
4746	*0.64	7.9	7.1	66.4	0.44	94	91.5	0.215	7.8
4753	0.39	7.6	7.1	67.5	0.74	90	94.1	--	7.1
4756	0.51	8.6	8.4	66.0	1.07	93	90.8	0.111	8.4
4757	0.72	8.0	7.2	63.9	0.56	99	91.9	0.074	7.2
4760	0.50	7.9	7.7	65.3	0.59	--	94.6	0.080	7.7
4764	0.18	8.5	8.2	69.1	0.64	95	94.1	0.071	8.2
4765	0.44	8.0	8.9	67.7	0.58	[illegible]	91.2	0.054	8.8
4768	*0.61	8.6	--	62.1	0.49	83	90.9	0.100	8.0
4771	0.16	8.0	8.1	65.6	0.46	96	93.8	0.178	8.2
4772	0.43	8.3	8.5	66.4	0.35	[illegible]	90.2	--	8.4
4775	0.37	8.7	8.9	64.0	0.77	97	92.1	0.075	8.9
4777	0.27	8.0	--	67.3	0.38	93	91.9	0.018	8.8
4778	0.25	8.9	8.5	70.2	0.78	89	91.2	0.066	8.4
4779	0.58	7.5	6.8	63.2	1.43	95	93.2	0.099	6.8
4783	0.15	8.8	7.0	62.5	0.36	92	92.3	--	--
4784	*0.48	8.6	9.6	64.7	0.32	100	--	0.037	8.4
4790	--	-	-	66.8	0.24	93	94.5	0.005	9.8
4795	0.43	7.8	7.8	60.9	0.37	90	92.6	0.077	7.9
Avg.(A)	0.40	8.25	8.59	65.5	0.577	92.5	92.0	0.063	--
Avg.(B)	0.39	8.18	8.20	66.6	0.642	92.4	92.2	0.076	--

* A portion or all of sulphuring applied to thick juice. All others used sulphuring of thin juice only.

(5) White Massecuites (Table 3). About 80% of the white massecuite purities are between 90 and 93% purity, only 1% are below 90%, and 19% are over 93% purity. The annual mean purity is the same as the past 6-year average. The massecuite Brix, pH and the cu. ft. of massecuite per 100 lbs. of sugar, all show a normal average value.

(6) Washing of White Sugar (Table 3). The wash water used at the non-Steffen factories averaged slightly more than last year, but was lower at Steffen factories. The general average of 15.75 quarts of water per machine was unchanged.

As pointed out in the last report, the high wash purity shows fair correlation with the sugar quality; that is, the higher the wash purity the better the quality of the sugar produced. Other factors are undoubtedly involved but to a considerable extent sugar quality is made in the centrifuge. The high wash purities reported average slightly higher than in 1946 and may in part account for the better sugar quality this year.

(7) Moisture in White Sugar (Table 3). The moisture in white sugars averaged slightly below the values in the previous campaign - in fact, were the lowest since 1944.

(8) Raw Massecuites and Sugar (Table 4). High and low raw massecuites showed essentially the same purity, Brix, and yield of sugar per cu. ft. of massecuite as in 1946. The average high and low raw sugar purities were higher than previously, especially for Steffen operations, and may have produced the slightly higher white massecuite purities. The average increase in raw sugar purities was 0.4°.

(9) Molasses Production (data not tabulated). This is the first year that data on molasses produced by non-Steffen factories and on the sucrose lost in molasses were sought and obtained in a form suitable for critical study. The

TABLE 3

SUGAR END PROCESSING

(A) Non-Steffen Operations

	White Massecuite				White Sugar Washing				Sugar as Sacked	
					Water Used					
Key No.	pH	Purity	Brix	Cu.Ft. Per 100 Sugar	Temp. C°	Qts.Per Machine	Qts.Per 100 Sug.	High Wash Purity	Temp. C°	Moisture %
4703	9.0	91.5	90.0	3.30	[illegible]	[illegible]	3.42	91.2	36	0.031
4704	8.9	91.8	92.5	2.83	98	7.0	2.2	93.6	56	0.024
4705	9.4	92.5	90.9	3.1	104	16.0	5.3	93.0	44	0.036
4706A	8.1	92.3	92.1	--	130	12.0	3.8	91.9	--	0.026
4706B	7.1	92.4	91.9	--	130	12.0	3.8	90.0	--	0.030
4708	9.1	92.5	91.7	3.05	97	18.0	6.7	91.4	48	0.046
4709	9.7	91.8	91.6	3.72	95	15.0	--	90.3	42	0.037
4710	8.9	91.3	90.9	3.33	91	16.0	6.6	90.1	31	0.013
4711	8.8	90.9	91.5	--	96	18.0	6.5	91.0	41	0.016
4712	7.0	92.5	91.4	2.74	90	15.0	4.9	89.3	67	0.025
4713	7.9	92.7	91.6	--	98	16.0	4.0	93.3	45	0.012
4714	9.3	91.7	92.6	3.28	101	14.0	--	91.3	39	0.021
4715	7.8	92.3	92.0	2.90	112	21.0	5.4	94.9	49	0.021
4716	8.8	92.3	91.8	3.18	101	13.0	3.2	--	47	0.042
4717	--	93.7	91.7	3.13	95	17.0	4.9	94.7	46	0.022
4721	8.2	91.8	90.7	3.15	97	18.0	5.2	--	44	0.026
4722	9.0	91.2	90.8	3.18	93	16.0	5.6	90.8	39	0.013
4725	8.4	91.5	91.5	2.85	95	17.0	7.5	90.2	37	0.017
4727	9.5	91.5	91.4	2.61	100	15.0	5.0	90.1	31	0.034
4732	8.5	91.9	91.6	2.96	92	16.0	6.2	92.6	34	0.018
4733	7.2	87.2	91.7	3.26	95	20.0	6.7	85.6	50	--
4734	8.3	93.0	91.9	2.72	99	16.0	3.0	94.0	49	0.021
4735	8.2	93.8	91.5	3.02	90	14.0	4.4	95.3	58	0.025
4739	8.0	96.6	89.6	3.15	95	14.0	3.5	95.6	47	0.031
4743	9.0	92.7	90.2	3.15	94	17.0	5.4	90.7	43	0.025
4744	9.1	91.0	90.9	3.02	93	14.0	--	--	37	0.023
4745	8.1	92.6	92.4	--	92	15.4	6.2	90.8	52	0.025
4747	8.3	91.5	91.8	2.24	105	15.6	3.6	91.4	38	0.025
4749	--	93.8	90.6	2.90	93	17.0	--	92.3	56	0.029
4750	9.1	92.8	90.9	--	93	16.0	6.0	91.7	42	0.027
4751	8.0	90.7	90.0	3.26	100	16.0	--	91.3	38	0.026
4752	8.6	90.6	92.1	2.73	90	17.0	6.5	89.9	42	0.025
4754	--	93.5	91.0	--	97	10.0	--	94.4	41	0.029
4755	8.6	91.7	90.2	--	90	15.0	5.0	91.3	48	0.030
4758	9.0	91.0	91.2	--	--	--	--	--	--	0.030
4759	8.1	91.9	90.8	2.97	94	14.0	4.8	91.8	50	0.046
4761	7.1	94.5	91.2	--	93	--	--	93.5	59	0.033
4762	8.2	92.4	91.7	2.76	92	16.0	5.0	91.0	40	0.030
4763	9.1	90.3	93.6	2.84	97	13.5	4.7	88.5	56	0.029
4766	8.3	92.8	91.0	3.15	94	15.5	4.3	92.9	46	0.020
4769	8.3	91.4	91.7	--	90	17.0	5.4	90.3	57	0.029
4773	8.8	92.6	91.9	2.82	96	16.3	5.4	93.3	35	0.028

TABLE 3 - Continued

	White Massecuite				White Sugar Washing				Sugar as Sacked	
Key No.	pH	Purity	Brix	Cu.Ft. Per 100 Sugar	Temp. C°	Qts.Per Machine	Qts.Per 100 Sug.	High Wash Purity	Temp. C°	Moisture %
4776	7.7	93.0	91.8	3.00	111	15.0	5.0	95.1	41	0.025
4780	8.2	90.9	92.5	--	116	17.0	5.5	--	46	0.038
4782	9.0	91.6	90.8	--	92	18.0	7.2	89.9	31	0.019
4791	8.9	92.0	91.5	2.95	50	11.0	4.1	90.8	55	0.022
4793	8.5	92.2	90.6	2.90	110	17.0	4.8	93.9	--	0.069
4794	8.9	91.9	92.0	3.22	124	17.9	6.5	92.9	36	0.029
(B) Steffen Operations										
4702A	8.6	93.4	92.7	2.84	98	15.2	6.1	94.5	41	0.028
4702B	8.2	92.4	92.4	--	100	14.0	5.6	95.2	42	0.028
4707	8.8	92.1	90.5	3.04	96	16.0	5.7	90.2	38	0.030
4720	7.9	92.2	91.6	3.18	95	13.0	5.2	89.5	55	0.035
4724	8.7	92.4	92.4	--	95	16.0	5.5	91.3	32	0.018
4726	8.5	91.1	91.1	3.70	95	18.0	8.5	90.2	35	0.024
4728	8.3	90.0	91.5	--	91	16.0	--	88.7	52	0.055
4729	8.3	92.5	90.9	--	115	15.0	5.0	91.9	36	0.030
4730	8.5	91.6	90.1	--	91	15.0	7.0	90.1	36	0.035
4731	--	92.1	89.4	2.90	104	14.3	4.6	93.7	68	0.040
4737	7.7	92.2	91.5	2.76	107	17.0	4.0	90.4	31	0.035
4740	7.1	92.2	90.8	3.53	95	16.0	6.0	90.5	57	0.029
4741	8.4	92.2	91.0	2.92	100	18.0	6.6	90.4	40	0.032
4742	8.5	92.5	91.1	3.09	94	18.0	--	91.4	48	0.021
4746	--	91.6	90.9	3.30	98	23.0	--	93.3	46	0.024
4753	7.4	94.3	91.3	2.84	95	11.4	--	93.1	50	0.020
4756	8.4	90.9	91.5	3.32	94	14.0	5.8	91.6	36	0.015
4757	--	92.2	90.6	3.49	100	16.0	6.2	--	56	0.039
4760	--	94.6	89.8	2.77	113	16.1	--	96.0	40	0.030
4764	7.9	94.2	90.5	3.04	92	16.0	6.1	92.5	40	0.038
4765	8.8	91.3	89.7	2.92	93	18.0	--	90.0	29	0.034
4768	8.0	91.3	90.7	3.12	90	18.0	7.0	89.4	62	0.037
4771	7.7	93.7	90.9	3.19	94	15.3	5.4	94.0	42	0.030
4772	8.4	90.2	91.8	--	94	15.0	6.0	90.2	47	0.018
4775	8.6	92.3	91.2	3.10	97	13.0	5.0	90.6	48	0.028
4777	8.9	92.2	90.6	--	96	16.0	5.7	91.3	52	0.036
4778	8.1	91.3	92.9	2.73	94	14.0	5.0	90.9	46	0.023
4779	7.0	93.3	90.0	--	96	13.9	4.2	--	41	0.039
4783	7.8	92.4	91.5	2.65	--	21.9	5.3	--	30	0.017
4784	8.3	92.7	91.4	2.56	98	17.0	3.6	90.6	54	0.034
4790	--	94.5	89.9	3.31	120	12.0	--	94.0	--	0.032
4795	7.5	92.9	90.2	3.03	110	16.0	4.8	92.7	46	0.031
Avg.(A)	8.47	92.1	91.4	3.01	97.8	15.6	5.1	91.7	44.7	0.027
Avg.(B)	8.18	92.2	91.1	3.05	97.4	16.0	5.6	91.5	44.3	0.030

TABLE 4

RAW SUGAR PROCESSING

(A) Non-Steffen Operations

Key No.	High Raw Massecuite Purity	High Raw Massecuite Brix	High Raw Massecuite Cu.Ft.Per 100 White Sugar	High Raw Sugar Purity	Low Raw Massecuite Purity	Low Raw Massecuite Brix	Low Raw Massecuite Cu.Ft.Per 100 White Sugar	Low Raw Sugar Purity	Carbon Used Lbs. Per 100 White Sugar
4703	82.8	92.0	1.45	97.7	73.6	97.0	0.63	92.4	0.0
4704	83.6	92.7	0.97	98.2	74.8	92.1	0.55	93.9	0.0
4705	84.8	92.9	1.80	97.7	74.5	95.3	--	90.0	0.02
4706A	86.7	92.7	--	98.3	76.3	93.5	--	92.7	0.0
4706B	86.1	92.8	--	98.0	75.8	93.4	--	93.3	0.0
4708	83.7	93.8	1.42	97.4	74.4	94.0	0.45	89.5	0.002
4709	85.3	91.2	1.61	96.2	77.1	92.3	0.77	--	0.0
4710	82.8	93.0	1.22	--	73.3	96.8	0.53	--	0.0
4711	83.8	94.3	1.30	98.4	72.6	97.7	0.73	88.4	0.0
4712	85.9	93.4	0.94	98.0	75.4	93.0	0.50	91.9	0.07
4713	85.7	92.9	3.40	97.9	77.7	93.5	0.80	94.3	0.03
4714	82.8	94.0	1.73	97.1	72.4	95.2	0.20	90.6	0.03
4715	86.0	92.7	1.48	99.3	76.8	92.8	1.07	95.1	0.14
4716	85.3	93.3	1.67	97.2	73.2	94.4	0.73	89.0	0.0
4717	88.0	91.9	1.36	98.5	73.8	93.9	0.76	88.0	0.0
4721	85.8	91.3	1.37	98.7	75.7	91.4	[illegible]	95.8	0.0
4722	82.2	93.8	1.63	96.5	72.5	96.4	0.61	[illegible]	0.0
4725	81.4	93.6	0.95	--	71.8	96.8	0.45	--	0.0
4727	84.9	92.4	1.06	98.5	75.6	94.4	0.71	95.2	0.20
4732	84.7	93.2	1.16	98.3	72.4	97.1	0.56	88.6	0.0
4733	--	--	--	--	74.1	93.7	0.68	94.3	0.0
4734	[illegible]	92.8	2.15	[illegible]	[illegible]	95.3	[illegible]	[illegible]	0.02
4735	87.2	92.4	2.04	98.5	76.0	94.3	0.66	[illegible]	0.05
4739	80.1	90.6	0.64	96.6	75.1	91.7	0.29	94.5	0.04
4743	84.3	93.7	1.26	98.8	73.3	96.0	0.13	89.1	0.0
4744	82.9	92.5	1.30	97.5	73.2	96.6	0.66	91.3	0.30
4745	86.2	92.9	1.05	98.0	76.8	93.0	0.70	96.4	0.0
4747	84.3	91.2	0.82	[illegible]	74.0	93.4	0.71	96.3	0.176
4749	87.2	90.7	1.14	98.2	73.0	92.1	0.53	94.9	0.09
4750	82.9	92.6	1.42	97.7	72.9	97.6	0.46	92.0	0.0
4751	85.2	92.4	1.72	96.6	77.0	94.5	1.20	92.1	0.0
4752	--	--	--	--	76.9	94.2	0.79	--	0.0
4754	86.9	91.7	1.05	98.5	[illegible]	92.9	0.56	92.4	0.14
4755	85.8	91.2	--	97.8	76.8	92.4	--	95.4	0.0
4758	85.6	[illegible]	1.36	--	77.5	[illegible]	[illegible]	--	0.0
4759	85.4	92.5	1.21	95.9	74.4	96.6	0.51	[illegible]	0.0
4761	86.5	91.3	1.02	96.6	75.0	92.5	0.46	91.9	0.10
4762	83.6	91.7	--	[illegible]	75.5	92.5	--	94.4	0.12
4763	81.1	95.1	[illegible]	[illegible]	75.7	[illegible]	[illegible]	94.3	0.0
4766	84.5	91.1	[illegible]	98.2	70.7	91.5	0.71	[illegible]	0.127
4769	84.5	91.9	[illegible]	97.2	75.0	--	0.79	92.0	0.02
4773	84.9	95.2	1.21	[illegible]	75.1	97.6	0.59	91.5	0.03

TABLE 4 - Continued

Key No.	High Raw Massecuite Purity	High Raw Massecuite Brix	High Raw Massecuite Cu.Ft.Per 100 White Sugar	High Raw Sugar Purity	Low Raw Massecuite Purity	Low Raw Massecuite Brix	Low Raw Massecuite Cu.Ft.Per 100 White Sugar	Low Raw Sugar Purity	Carbon Used Lbs. Per 100 White Sugar
4776	85.1	92.6	1.44	97.8	74.0	93.2	0.38	90.8	0.10
4780	83.9	94.0	1.77	96.2	73.2	95.2	0.71	88.8	0.0
4782	83.4	93.2	1.00	96.6	73.4	96.9	0.55	89.3	0.0
4791	84.7	93.0	0.97	96.0	75.7	94.6	0.69	94.0	0.195
4793	85.3	92.0	1.53	98.1	76.3	94.1	0.87	86.6	0.42
4794	84.8	86.7	1.12	97.7	75.7	93.2	0.62	92.9	0.0
(B) Steffen Operations									
4702A	87.3	94.1	2.70	98.9	76.8	95.6	0.95	92.4	0.11
4702B	87.9	93.8	2.71	99.2	77.8	95.0	0.95	94.0	0.08
4707	85.0	92.2	1.55	95.8	75.2	94.4	0.61	87.9	0.06
4720	86.6	91.3	1.25	97.0	77.8	93.1	0.62	95.8	0.04
4724	84.9	92.6	1.20	96.3	74.8	94.7	0.60	91.4	0.0
4726	84.0	91.9	1.82	96.5	75.8	94.1	0.87	91.0	4.00
4728	82.2	91.0	--	97.4	77.4	93.6	--	96.8	0.08
4729	86.0	92.2	1.62	97.0	76.5	93.2	0.66	92.8	0.0
4730	85.0	91.7	3.66	96.9	76.4	95.5	0.74	90.3	0.0
4731	85.2	90.4	1.40	99.6	75.9	90.6	0.91	94.3	0.244
4737	86.2	92.3	1.53	97.4	77.9	92.7	0.77	93.0	0.04
4740	86.8	91.5	1.22	96.2	78.2	90.6	0.63	90.3	0.17
4741	84.4	92.7	1.33	97.1	75.2	94.3	0.59	87.9	0.0
4742	83.6	91.0	1.67	--	76.1	93.3	0.64	--	0.0
4746	85.7	91.4	1.45	99.4	78.2	92.8	1.20	93.2	0.08
4753	88.1	92.2	1.01	99.5	79.5	94.1	0.53	91.7	0.11
4756	82.7	93.3	1.88	--	72.4	96.6	0.83	88.4	0.07
4757	86.4	91.1	2.15	99.6	76.2	91.6	1.08	94.2	0.12
4760	89.3	89.9	1.34	99.4	81.1	91.3	0.75	95.7	0.0
4764	86.2	92.7	3.01	99.2	76.2	95.2	1.01	92.0	0.098
4765	83.9	91.0	1.47	95.5	74.1	94.4	0.68	88.7	0.0
4768	84.6	91.5	1.42	98.2	74.7	92.7	0.75	91.1	0.0
4771	88.7	91.2	1.73	98.5	80.8	92.0	0.96	96.7	0.0
4772	82.9	92.6	1.65	94.8	73.8	96.0	0.80	88.4	0.0
4775	85.3	92.6	1.37	98.6	75.3	94.0	0.73	98.6	0.13
4777	86.1	92.7	1.18	97.7	76.5	93.4	0.59	92.2	0.01
4778	86.3	94.7	1.79	97.8	76.2	96.8	1.08	93.6	0.11
4779	87.1	90.3	1.29	98.6	79.1	91.1	0.65	93.8	0.05
4783	86.2	92.1	1.18	98.7	76.2	92.3	0.83	98.0	0.0
4784	87.0	91.2	1.32	97.1	77.5	92.5	0.57	92.9	0.009
4795	85.8	90.8	1.66	98.0	77.4	91.9	0.70	94.0	0.0
Avg.(A)	84.9	92.4	1.38	97.7	75.1	94.5	0.65	92.4	--
Avg.(B)	85.7	92.0	1.69	97.8	76.7	93.6	0.78	92.7	--

sucrose loss in molasses ranged from 1.63% to 3.09% on beets. It is commonly known that the amount of loss is largely the result of the total quantity of nonsugars and their composition, plus some effect from the processing efficiency. The following tabulated values give evidence of the correlation of sugar loss in molasses with nonsugars in the beet juice. The factory grouping is by increasing loss of sugar.

SUGAR LOSS IN MOLASSES VS. NONSUGARS

Group	No. of Factories	Sugar Loss in Molasses % Beets		Molasses Nonsugars % Beets		Diffusion Juice	
		Range	Average	Range	Average	Nonsugars % Beets	Purity
1.	6	1.63-1.79	1.72	0.97-1.29	1.14	2.08	88.5
2.	6	1.80-1.87	1.85	1.08-1.35	1.25	2.11	88.1
3.	4	1.93-2.08	2.00	1.21-1.49	1.35	2.35	87.0
4.	9	2.11-2,23	2.16	1.20-1.85	1.53	2.50	86.3
5.	6	2.35-2.47	2.41	1.41-1.72	1.60	2.55	86.0
6.	8	2.53-2.69	2,58	1.53-1.71	1.63	2.64	85.3
7.	3	2.79-3.09	2.98	1.85-2.14	1.98	3.09	83.2

It is noted that the range of molasses nonsugars associated with a particular range of sugar loss is quite small, with the exception of group 4. In this group are two factories which reported very low molasses purities yet normal yield of molasses so that the sugar loss is low compared with the high apparent nonsugars. The nonsugars as calculated on all samples are apparent nonsugars because the Brix of molasses used in the calculation is not the true dry solids. The average sugar loss per unit nonsugars in molasses is 1 1/2 pounds of sugar for each pound of nonsugars. On a dry solids basis the loss of sugar per unit of true nonsugars would be of the order of 1.75.

Data from the factories using ion exchange were not used in this study. There is some indication that the sugar loss per unit of nonsugar in molasses is about 1.4; in other words, less than under normal conditions.

The difference between nonsugars of diffusion juice and of molasses (on the beet basis) is fairly uniform for the various groups. This means that when juice nonsugars are high the proportion removed by clarification is smaller although the amount removed (% beets) is normal. For example, in group 1 the estimated removal of nonsugars (% beets) by clarification is 45.2% of the diffusion juice nonsugars; while for group 7, the removal is only 35.9%. Since most of the coagulable protein is left in the battery, it can be assumed that the material removed in clarification is largely phosphates, oxalates, and semi-colloidal substances.

(10) Beet Storage. Practically 12 million tons of beets were sliced in the 1946 campaign. Of this total nearly 5 million tons were processed after pile storage. In addition to normal storage losses in some areas the spoilage loss was especially heavy. Commercial experimentation with supplemental ventilation was expanded and again indicated considerable benefits in conserving sugar values. The savings of sugar that are possible through reduction of losses between harvesting and slicing exceed those that can be obtained through efficiency of processing. An even more intensive effort by the industry to solve the problems involved is fully justified. The losses of this past campaign may have approached 10 million dollars. Half of this loss should be preventable.

B. Chemical and Physical Data on the Composite Sugars

(1) Ash Content (Table 5). As in the previous campaigns, ash values are calculated on the basis of specific conductivity by the procedures proposed in the report for the 1944 campaign, pages 26-32. Gravimetric ash was determined on a few samples of low conductivity to check the established values and reasonable good agreement was obtained. Specific conductivity was determined

on a solution of 30 grams sugar in 100 cc. volume, which was the technique adopted in 1940 when this determination was first reported. This concentration was chosen because it was the point of maximum conductivity for the majority of the sugars and was little changed by even 1 gram deviations in the amount of sugar used. The sulphated ash reported is the full amount, without any deduction; but, being calculated on an ionic basis, ash values do not include silica.

For the non-Steffen sugars the conductivity and ash are essentially the same as last year; but for the Steffen sugars, the means are significantly lower than in 1946. The general averages are better than in any years except 1940 and 1941. This is in line with the slightly higher white pan purities and the slight increase in the quantity of wash water used. The sugars from 46 factories showed a lower ash than last campaign and only 23 sugars were higher in ash.

While the total nonsugars in white massecuite has some effect on the quantity of ash in the sugar produced, it is the concentrations of specific nonsugars that are most readily taken up during the crystallization of the sucrose which are the most influential; namely, the sulphates, sulphites, and lime. As mentioned before, the ash in sugar is very susceptible to the efficiency of the washing operation and the correlation of white massecuite composition and sugar quality is always erratic unless sugar boiling and centrifugal work are strictly uniform. Sugar quality definitely shows no correlation with the total nonsugars in the beet juices since the intermediate processing is usually handled to produce a good white massecuite purity irrespective of the juice purity.

(2) Sulphites (Table 5). The average sulphites (as SO_2) in non-Steffen sugars was about the same as last season, while in Steffen sugars the value was a little lower. The general mean of seven parts per million has only been bettered twice before, in 1942 and 1945. This was in spite of the fact that five sugars

TABLE 5

MINERAL COMPONENTS OF SUGARS

(A) Non-Steffen Sugars

Key No.	Specific Conductivity X 10^{-6}	Mineral Analyses in p.p.m.				Calculated Ash Content in p.p.m.		Calculated Salts Content in p.p.m.		
		SO_2	SO_3	Cl	CaO	Carbonate	Sulphated	Mineral	Organic	Total
4703	26.3	8	5	7	6	102	131	42	116	158
4704	31.8	3	12	12	8	123	158	55	135	190
4705	29.3	2	15	2	4	116	149	39	150	189
4706A	21.3	4	2	10	4	83	106	33	94	127
4706B	22.0	5	2	5	8	87	112	25	115	140
4708	28.3	3	5	5	6	112	144	27	160	187
4709	27.0	trace	5	0	6	113	145	11	184	195
4710	18.8	6	5	2	3	73	94	28	88	116
4711	20.3	5	9	9	5	77	99	48	64	112
4712	48.8	37	16	24	8	177	227	165	62	227
4713	22.0	trace	3	1	11	92	118	9	149	158
4714	25.8	2	5	12	4	101	129	38	118	156
4715	19.3	8	6	1	9	75	96	33	84	117
4716	23.8	5	9	2	6	93	119	34	113	147
4717	16.5	6	1	7	4	63	81	29	66	95
4721	26.2	10	6	2	4	102	131	39	122	161
4722	20.6	5	7	2	6	80	103	30	98	128
4725	23.8	12	8	10	5	89	114	63	61	124
4727	29.5	1	1	1	6	124	159	6	208	214
4732	19.0	10	8	5	5	71	91	49	53	102
4733	26.2	19	14	6	10	96	123	84	44	128
4734	16.8	3	9	12	6	62	80	49	30	79
4735	16.3	7	13	6	4	65	83	54	35	89
4739	10.0	trace	2	0	6	46	59	4	75	79
4743	21.8	6	12	3	3	83	106	44	82	126
4744A	27.5	5	12	11	11	104	134	57	98	155
4744B	25.8	6	13	9	5	97	125	58	86	144
4745	27.2	3	6	16	6	104	133	50	105	155
4747	27.3	1	7	2	3	111	143	20	167	187
4749	25.0	22	9	5	2	107	137	79	70	149
4750	18.8	5	9	4	4	72	92	38	70	108
4752	44.0	4	16	5	9	174	223	52	233	285
4754	26.0	15	13	5	5	97	125	71	67	138
4755	19.8	7	9	2	6	76	97	38	78	116
4758	37.2	2	8	2	13	151	194	25	232	257
4759	37.2	25	22	16	2	133	171	134	35	169
4761	30.0	32	10	16	4	108	139	125	0	125
4762	31.5	3	8	15	12	122	156	53	134	187
4763	28.1	3	4	15	3	109	140	44	123	167
4766	22.2	4	6	3	6	88	113	27	115	142
4769	29.8	12	13	6	4	113	145	66	102	168
4773	24.2	2	8	9	17	94	121	39	108	147
4776	13.0	1	5	2	6	51	66	16	67	83
4780	26.8	5	10	15	8	101	130	61	86	147
4782	21.5	5	9	4	3	87	111	38	98	136

TABLE 5 - CONTINUED

Key No.	Specific Conductivity X 10^{-6}	Mineral Analyses in p.p.m. SiO_2	SO_3	Cl	CaO	Calculated Ash Content in p.p.m. Carbonate	Sulphated	Calculated Salts Content in p.p.m. Mineral	Organic	Total
4691	31.0	2	10	1	6	125	160	27	182	209
4791	34.8	3	8	11	8	137	176	44	175	219
4791C	17.0	0	18	1	22	65	83	39	61	100
4793	27.2	5	6	2	8	108	138	28	150	178
4794	26.5	4	9	3	6	104	134	34	136	170
Avg.(A)	25.21	7.3	8.4	6.8	6.2	97.9	125.6	47.3	101.8	149.1
(B) Steffen Sugars										
4702A	18.1	1	1	6	4	72	92	16	102	118
4702B	17.8	trace	2	4	5	72	93	13	108	121
4707	23.2	4	2	1	2	95	122	18	146	164
4720	36.4	14	11	13	5	138	177	80	123	203
4724	27.0	6	9	10	6	103	132	52	104	156
4726	28.7	3	8	8	8	112	144	39	141	180
4728	45.7	7	13	24	8	174	223	89	169	258
4729	26.2	3	4	10	6	103	132	35	128	163
4730	34.8	8	12	10	10	134	172	62	143	205
4731	24.0	7	7	5	6	93	119	40	104	144
4737	36.0	7	12	5	8	141	181	50	175	225
4740	33.0	27	13	7	3	121	155	102	61	163
4741	27.5	5	11	3	8	108	138	40	133	173
4742	24.6	7	9	4	6	95	122	42	106	148
4746	17.8	3	7	2	7	69	89	25	86	111
4753	27.8	14	10	4	3	105	135	60	97	157
4756A	24,5	5	14	8	8	93	119	56	82	138
4756B	21.8	4	12	8	4	83	106	49	73	122
4757	24.0	7	11	9	7	91	117	56	79	135
4760	24.0	10	21	3	8	89	114	72	54	126
4764	15.0	1	2	5	5	59	76	10	80	90
4765	31.4	6	11	8	5	122	156	52	138	190
4768	44.5	11	14	7	8	174	223	68	207	275
4771	18.9	1	7	3	10	75	96	23	100	123
4772	32.8	5	19	11	8	125	160	72	114	186
4775	46.2	2	19	19	11	179	230	81	195	276
4777	32.3	4	13	7	4	126	162	49	150	199
4778	25.8	2	7	15	7	98	126	48	100	148
4779	32.2	14	13	7	8	122	157	72	108	180
4783	15,6	3	4	3	6	62	80	21	79	100
4784	27.2	7	10	4	5	105	135	44	121	165
4790	33.0	trace	6	1	2	139	178	19	218	237
4795	25.7	7	8	1	10	101	130	34	129	164
Avg.(B)	27.90	6.6	9.9	7.5	6.4	107.7	138.2	49.7	116.3	166.0
Avg. **	26.31	7.0	9.0	7.1	6.3	101.9	130.7	48.3	107.7	156.0

** General average.

showed sulphites in excess of 20 p.p.m. Nearly 60% of the sugars contained only 5 parts per million or less.

The factory that has operated without sulphuring the past two campaigns produced a sugar with a color in solution triple that of the previous sulphitation campaign and the reflectance test was lower by 2%. However, the ash in the sugar was only half as high and the foaming test was significantly better. While factors other than the omission of sulphuring may have influenced these results, the trend in respect to color, reflectance and ash is as would be expected.

(3) Sulphates (Table 5). Both Steffen and non-Steffen sugars averaged lower in sulphates (SO_3) than last season. The general average of nine p.p.m. has been bettered in three earlier years. About 60% of the sugars were below ten p.p.m. and only two sugars exceeded 20 p.p.m. sulphates.

(4) Chlorides (Table 5). Chlorides (Cl) also averaged lower than for the 1946 campaign. The general average of 7.1 p.p.m. is not exceptionally low as in seven other recent years chlorides have been below this value. Only two sugars had chlorides in excess of 20 p.p.m. and 80% of the sugars had only 10 p.p.m. or less.

(5) Lime (Table 5). Lime (CaO) showed a very slight increase over the previous season. There has been an upward trend since 1940 which corresponds to the rather regular increase in lime salts reported on standard liquor. About 40% of the sugars had only 5 p.p.m. or less.

(6) Mineral and Organic Salts (Table 5). Salt contents, like sulphated ash, are lower in the 1947 sugars than for the previous year. In fact, mineral salts are the lowest of the past 5 years. Organic salts did not decrease as much and consequently form a greater proportion of the total salts than normal.

The sugar from the factory that operated by the ion exchange process most of the campaign shows a 95% lower mineral salts than usual, but only a 15% lower organic salts. The total salts were 56% below normal.

(7) Reflectance (Table 6). Average reflectance reached a new high; only one of the regular samples was below 90%. No instrumental difficulties could be found to account for this improvement; but even if this were the explanation, the comparison between samples would be unaffected.

(8) Color and Turbidity in Solution (Table 6). Both color and turbidity measure higher than for 5 years. Six sugars showed over 10 units of turbidity and the same number had colors of over 5 units. Non-Steffen and Steffen sugars averaged alike. The ion exchange sugar, while of exceptionally high reflectance, was average in solution color and turbidity.

(9) Foaming Test (Table 6). Initial foaming was at an especially low value although the final foaming agrees with the previous 2 years. There was no change in the technique used. The foaming tests are the lowest since 1936.

(10) Formula Rating Percentages (Table 6). The high reflectances, low foaming test, and lower ashes more than offset the small increases in color and turbidity; and the rating percentages show a pronounced improvement. In fact 12 sugars bettered the standard sugar quality set up in 1941; that is, exceeded a 100% rating.

(11) Screening Tests (Table 7). As for the past 2 years, the screening tests were made on 100-gram aliquots prepared by use of a Jones Sample riffle. The fineness moduli were calculated by the method of Nees and show an average increase in crystal size over last season. Slightly larger amounts were retained on screens nos. 30, 40, and 50.

TABLE 6

PHYSICAL PROPERTIES AND RATING OF SUGARS

(A) Non-Steffen Sugars

Key No.	Reflectance	Sugar Solution			Foaming Test		Formula Rating Percentage	Fineness Moduli
		Color	Turbidity	pH	Maximum	Final		
4703	93.2	3.1	1.4	7.31	90	75	96.6	41.1
4704	94.5	4.0	4.6	7.35	90	75	95.4	76.8
4705	94.0	4.1	4.6	7.47	100	80	93.7	40.9
4706A	95.0	3.7	3.3	7.28	95	80	97.2	36.2
4706B	94.0	4.5	3.3	7.01	100	85	94.0	55.8
4708	95.1	4.9	4.1	7.20	95	70	94.9	57.6
4709	91.0	6.7	6.8	7.40	85	70	87.6	39.9
4710	94.8	2.8	2.7	7.42	95	80	98.3	53.9
4711	96.3	2.1	3.3	7.30	90	80	101.3	48.5
4712	93.6	1.8	12.2	6.70	85	75	87.9	51.8
4713	94.3	2.1	5.0	6.85	90	80	98.2	46.4
4714	95.8	2.7	3.9	6.73	90	75	99.6	47.4
4715	97.1	2.9	3.1	6.58	95	80	100.5	34.3
4716	96.9	3.6	4.2	6.85	95	80	98.8	36.1
4717	95.8	2.0	6.6	6.85	85	75	99.5	52.5
4721	96.3	4.2	6.4	6.78	95	85	95.2	25.9
4722	93.2	1.2	4.2	7.00	90	80	98.0	48.3
4725	94.8	2.0	3.3	6.90	90	80	98.5	47.7
4727	95.6	2.7	3.6	7.30	95	80	98.6	40.7
4732	97.9	2.7	1.8	6.98	90	75	102.9	37.8
4733	94.5	2.4	12.2	6.78	100	80	90.0	40.8
4734	93.9	4.6	4.3	6.90	95	80	94.5	59.2
4735	96.0	3.9	3.2	6.91	95	80	98.1	40.9
4739	96.7	3.0	4.1	7.18	90	80	101.3	33.6
4743	95.8	3.2	5.8	7.26	90	80	97.6	35.0
4744A	94.2	3.6	2.7	7.09	90	85	96.8	38.0
4744B	95.8	2.4	2.1	7.30	95	75	100.0	37.7
4745	94.5	5.0	5.0	7.28	90	80	94.3	52.5
4747	94.8	1.6	2.0	7.15	90	75	100.8	66.8
4749	95.8	0.8	5.3	7.22	90	75	98.5	30.6
4750	95.6	1.4	1.1	7.33	95	80	102.1	22.2
4752	88.5	8.9	13.0	7.18	85	75	76.5	95.0
4754	94.3	1.8	11.0	6.45	85	80	93.5	39.3
4755	91.2	2.4	2.7	6.78	95	75	94.2	55.8
4758	91.8	2.9	11.7	6.98	90	80	88.8	69.1
4759	96.8	1.2	1.3	7.00	100	80	99.7	55.5
4761	93.8	2.8	7.7	6.71	90	75	90.8	60.6
4762	94.8	1.5	3.4	6.91	100	85	98.4	50.0
4763	93.0	3.0	3.9	7.15	90	80	95.5	64.0
4766	96.0	3.1	3.5	7.15	100	80	98.3	53.4
4769	96.0	2.4	2.2	7.05	100	80	98.6	28.5
4773	95.8	3.7	6.4	7.18	90	80	96.9	28.6
4776	95.7	4.2	7.2	7.40	100	85	95.2	42.0
4780	92.0	3.3	5.0	7.07	90	80	93.1	48.9

TABLE [illegible] - Continued

Key No.	Reflectance	Sugar Solution			Foaming Test		Formula Rating Percentage	Fineness Moduli
		Color	Turbidity	pH	Maximum	Final		
4762	98.5	3.3	5.6	7.20	85	60	101.6	30.1
4691	88.4	6.4	11.8	7.51	100	90	79.4	137.9
4791	88.3	3.0	7.6	7.52	85	60	96.3	136.4
4791C	89.6	2.9	13.5	7.52	80	70	97.3	66.4
4793	92.3	4.9	7.6	7.50	100	80	96.5	76.4
4794	93.2	5.2	3.4	7.50	100	85	92.0	52.1
(B) Steffen Sugars								
4702A	96.0	5.2	4.9	7.30	95	80	92.6	38.1
4702B	92.0	5.6	4.2	7.30	105	90	90.0	36.0
4707	93.2	3.7	2.2	7.09	90	75	96.0	45.3
4720	96.1	2.7	3.2	6.78	85	80	97.9	45.8
4724	92.5	1.8	2.5	6.98	90	75	96.9	49.0
4726	96.1	1.8	2.7	6.88	90	75	101.5	38.0
4728	92.8	4.5	4.9	7.14	100	90	90.0	60.6
4729	95.8	3.6	4.3	6.98	100	80	96.8	32.3
4730	95.9	3.2	4.5	7.00	90	60	97.4	62.4
4731	95.2	3.7	6.2	6.90	100	85	94.4	29.2
4737	95.2	5.2	4.6	6.78	85	80	94.7	41.0
4740	95.5	2.4	22.0	6.81	85	80	96.0	27.9
4741	96.0	3.7	5.8	7.00	95	75	96.3	39.7
4742	91.8	4.2	5.4	7.05	95	85	90.7	26.0
4746	95.5	1.5	6.7	7.16	90	80	96.3	39.5
4753	95.6	2.9	6.4	6.78	90	60	96.0	45.7
4756A	94.5	2.4	1.6	6.88	95	85	95.6	61.4
4756B	95.1	2.0	3.6	6.95	95	70	100.4	56.9
4757	95.8	3.3	3.0	6.75	90	75	96.5	77.5
4760	90.8	1.8	1.5	6.90	85	85	94.6	38.2
4764	93.6	5.1	2.4	7.15	105	85	93.6	52.3
4765	95.6	4.1	4.5	7.15	105	85	94.5	45.2
4766	94.7	2.5	2.0	6.93	95	85	96.7	56.1
4771	95.8	3.0	6.8	7.02	95	80	97.3	50.9
4772	96.7	2.2	3.1	7.02	95	80	100.4	40.6
4775	94.5	2.8	5.7	7.36	90	80	95.6	49.9
4777	96.5	1.7	5.7	7.05	95	80	99.3	44.5
4778	93.4	3.9	7.2	7.11	90	75	93.1	54.7
4779	94.8	2.4	4.3	7.08	100	85	95.4	23.9
4783	96.3	1.2	3.7	7.15	95	80	102.0	47.9
4784	94.3	0.8	4.5	7.16	100	80	97.8	27.7
4790	96.2	1.8	[illegible]	7.55	80	65	105.8	53.3
4795	95.7	4.5	4.5	7.20	120	100	92.3	32.0
Avg.(A)	94.73	3.11	4.91	7.06	92.4	[illegible]	96.26	46.6
Avg.(B)	94.73	3.05	4.64	7.02	94.0	81.0	96.02	44.6

TABLE 7

SCREENING TESTS ON SUGARS

(A) Non-Steffen Sugars

Key No.	Percent Retained on U. S. Screens Nos. 20	30	40	50	60	70	80	100	Through No. 100	Total on Nos. 40 and 50	Fineness Modulus
4703	0.0	1.3	25.6	35.2	14.2	11.3	5.6	4.5	2.3	60.8	41.1
4704	0.3	11.4	41.3	24.8	8.1	6.8	3.5	2.6	1.2	66.1	76.8
4705	0.0	1.2	25.0	34.9	15.3	12.0	6.2	4.4	1.0	59.9	40.9
4706A	0.0	0.4	21.8	35.5	15.2	12.9	6.9	5.0	2.3	57.3	36.2
4706B	0.0	5.0	34.4	30.2	11.9	9.8	4.4	3.4	0.9	64.6	55.8
4708	0.0	4.1	35.5	34.3	11.5	7.7	3.2	2.6	1.1	69.8	57.6
4709	0.1	3.1	22.4	31.6	16.0	13.3	6.5	5.1	1.9	54.0	39.9
4710	0.0	2.3	33.3	38.2	12.0	7.8	3.5	2.1	0.8	71.5	53.9
4711	0.0	1.0	28.3	43.8	13.2	7.3	3.0	2.2	1.2	72.1	48.5
4712	0.0	2.8	31.3	36.5	13.1	9.2	3.9	2.7	0.5	67.8	51.8
4713	0.1	3.2	28.0	32.6	13.8	11.4	5.4	4.5	1.0	60.6	46.4
4714	0.1	2.9	28.0	35.8	13.4	10.0	4.8	3.3	1.7	63.8	47.4
4715	0.1	1.1	20.9	33.1	14.1	12.7	6.5	6.9	4.6	54.0	34.3
4716	0.0	0.3	18.7	41.0	15.8	12.8	5.5	4.5	1.4	59.7	36.1
4717	0.0	1.7	33.0	38.9	11.3	8.4	3.5	2.7	0.5	71.9	52.5
4721	0.0	0.3	8.2	38.6	19.9	15.4	7.2	6.2	4.2	46.8	25.9
4722	0.0	2.2	30.2	36.2	12.0	9.8	5.0	3.2	1.3	66.4	48.3
4725	0.0	1.7	32.0	33.6	12.0	10.0	5.0	4.0	1.7	65.6	47.7
4727	0.0	1.7	26.8	31.9	13.2	11.5	6.0	5.3	3.6	58.7	40.7
4732	0.0	0.6	23.0	37.1	14.1	11.0	5.5	5.3	3.4	60.1	37.8
4733	0.0	1.0	29.0	35.0	12.3	9.3	4.9	5.0	3.5	64.0	40.8
4734	0.0	4.9	35.0	34.1	11.7	8.1	3.9	1.5	0.8	69.1	59.2
4735	0.0	0.5	23.7	40.0	14.5	11.5	5.0	3.8	1.0	63.7	40.9
4739	0.0	0.7	18.8	35.9	16.0	12.6	6.3	5.9	3.8	54.7	33.6
4743	0.0	1.2	21.0	33.3	15.0	13.0	6.7	5.8	4.0	54.3	35.0
4744A	0.0	2.2	24.5	31.0	12.5	11.4	7.2	6.8	4.4	55.5	36.0
4744B	0.0	0.5	21.0	41.0	14.5	10.0	5.0	4.9	3.1	61.0	37.7
4745	0.0	2.5	32.5	36.4	12.8	9.0	3.8	2.3	0.7	68.9	52.5
4747	0.0	3.2	43.8	34.5	9.0	5.2	2.2	1.4	0.7	78.3	66.8
4749	0.0	0.5	16.0	35.0	16.7	13.9	7.5	7.0	3.4	51.0	30.6
4750	0.0	0.2	6.5	32.9	19.5	18.3	9.7	8.5	4.4	39.4	22.2
4752	0.2	14.5	47.5	23.6	6.5	4.3	1.7	1.5	0.2	71.1	95.0
4754	0.0	0.9	24.0	37.5	13.0	10.5	5.5	5.3	3.3	61.5	30.3
4755	0.2	8.3	47.2	30.2	8.0	3.9	1.3	0.6	0.3	77.4	55.8
4758	0.6	10.9	33.2	29.8	11.3	8.0	3.5	2.0	0.7	63.0	69.1
4759	0.0	7.0	30.5	30.7	12.5	9.8	4.9	3.5	1.1	61.2	55.5
4761	0.0	3.2	38.0	36.0	11.1	6.9	3.0	1.4	0.4	74.0	60.6
4762	0.0	1.9	32.3	35.5	12.5	9.0	4.2	3.3	1.3	67.8	50.0
4763	0.0	5.3	37.9	34.1	11.0	7.1	3.0	1.2	0.4	72.0	64.0
4766	0.1	8.1	28.7	27.8	12.8	10.6	5.1	4.2	2.6	56.5	53.4
4769	0.0	0.2	15.6	33.5	16.0	13.8	8.0	7.9	5.0	49.1	26.5
4773	0.0	1.0	17.0	30.0	14.5	13.9	8.3	9.0	6.3	47.0	28.6
4776	0.0	1.0	24.2	39.8	14.8	10.0	5.0	3.8	1.4	64.0	42.0
4780	0.2	3.3	29.8	34.0	12.2	9.8	4.8	4.4	1.5	63.8	48.0
4782	0.0	1.0	17.8	32.5	13.0	13.1	8.2	8.2	6.2	50.3	30.1

TABLE 7 - Continued

Key No.	20	30	40	50	60	70	80	100	Through No. 100	Total on Nos. 40 and 50	Fineness Modulus
4691	0.0	28.5	44.1	19.5	5.0	2.0	0.5	0.2	0.2	63.6	137.9
4791	0.0	28.8	46.7	18.5	4.0	1.3	0.2	0.2	0.3	65.2	136.4
4791C	0.0	9.3	32.8	33.5	12.0	7.9	3.0	1.2	0.3	66.3	66.4
4793	1.2	11.0	37.8	28.2	9.8	7.0	2.7	2.0	0.3	66.0	76.4
4794	0.5	4.7	30.0	32.5	12.8	9.5	4.5	3.7	1.8	62.5	52.1
(B) Steffen Sugars											
4702A	0.0	0.5	24.0	34.5	15.3	12.7	5.8	5.0	2.2	58.5	38.1
4702B	0.0	0.5	23.7	33.3	13.6	11.7	7.0	6.0	4.2	57.0	36.0
4707	0.0	1.6	25.8	40.6	14.1	9.7	4.1	3.0	1.1	66.4	45.3
4720	0.0	0.5	27.2	43.0	13.8	7.7	3.3	3.0	1.5	70.2	45.8
4724	0.2	1.2	25.7	46.9	14.4	7.6	2.1	1.6	0.3	72.6	49.0
4726	0.0	1.5	23.0	34.0	14.1	12.5	6.5	5.9	2.5	57.0	38.0
4728	0.0	1.0	38.9	42.0	10.5	5.1	1.8	0.5	0.2	80.9	60.6
4729	0.0	1.0	17.6	35.0	16.3	12.7	6.6	6.3	4.5	52.6	32.3
4730	0.1	7.6	34.1	32.0	11.1	7.5	3.8	2.8	1.0	66.1	62.4
4731	0.1	0.3	15.3	34.3	15.9	14.7	7.8	7.5	4.1	49.6	29.2
4737	0.0	1.4	27.2	35.7	12.3	9.5	5.7	5.0	3.2	62.9	41.0
4740	0.0	0.1	9.9	40.2	19.1	14.7	7.0	6.3	2.7	50.1	27.9
4741	0.0	0.8	23.0	40.3	14.0	9.5	5.0	3.7	3.7	63.3	39.7
4742	0.0	0.2	13.2	34.0	15.0	13.0	8.6	9.5	6.5	47.2	26.0
4746	0.0	0.5	19.2	45.8	15.5	11.0	3.5	3.7	0.8	65.0	39.5
4753	0.0	1.7	31.0	33.1	11.1	9.9	5.8	5.1	2.3	64.1	45.7
4756A	0.1	3.5	39.2	35.5	8.9	6.0	2.9	2.8	1.1	74.7	61.4
4756B	0.1	2.7	35.4	38.7	10.0	6.3	2.8	2.4	1.6	74.1	56.9
4757	0.0	0.3	11.2	37.4	18.0	15.9	7.7	6.2	3.3	48.6	27.5
4760	0.0	1.0	21.7	37.5	15.5	11.4	6.2	4.8	1.9	59.2	38.2
4764	0.3	4.0	31.7	32.0	12.5	10.4	5.0	3.0	1.1	63.7	52.3
4765	0.0	2.5	28.0	35.2	12.6	9.4	4.8	4.7	2.8	63.2	45.2
4768	0.0	1.2	35.5	40.8	11.9	6.2	2.5	1.7	0.2	76.3	56.1
4771	0.0	2.2	29.8	40.0	13.0	9.0	3.5	2.0	0.5	69.8	50.9
4772	0.2	0.5	19.0	47.0	16.8	9.5	3.7	2.5	0.8	66.0	40.6
4775	0.0	1.0	24.2	39.8	14.8	10.0	5.0	3.8	1.4	64.0	49.9
4777	0.0	0.7	24.0	44.8	15.7	8.4	3.4	2.1	0.9	66.8	44.5
4778	0.0	4.4	33.5	32.0	12.3	9.5	4.5	2.7	1.1	65.5	54.7
4779	0.0	0.5	7.0	35.0	20.2	17.5	8.0	7.3	4.5	42.0	23.9
4783	0.1	0.9	26.8	45.0	13.5	8.0	3.0	2.2	0.5	71.8	47.9
4784	0.0	0.5	10.7	39.3	17.7	13.3	6.4	6.8	5.3	50.0	27.7
4790	1.0	7.0	28.7	34.6	14.0	7.5	3.6	2.5	1.1	63.3	58.3
4795	0.5	1.9	16.0	33.6	15.5	13.0	7.3	6.8	5.4	49.6	32.0
Avg.(A)	0.02	2.94	27.63	34.44	13.19	10.31	5.11	4.20	2.16	62.07	46.6
Avg.(B)	0.04	1.49	24.40	38.22	14.18	10.33	4.96	4.19	2.19	62.62	43.0

SUMMARY

It would appear that the slightly higher white pan purities and an increase in wash water produced sugars of higher than normal reflectance with lower ash and foaming. The overall improvement in quality shown by the formula percentage ratings is notable. This was accomplished in spite of a lower sucrose in beets and the pile storage of very large tonnages for extended periods of time.

PART II

BIOLOGICAL STUDIES OF SUGARS

By H. H. Hall and Dorothea J. Tennisson

The bacteriological quality of the sugars was determined by examining the samples for various microorganisms, particularly aerobic and anaerobic thermophilic bacteria, mesophilic bacteria, yeasts, and molds which might influence the desirable characteristics or keeping quality of canned foods, beverages, dairy products, frozen foods, desserts, candies, etc. Determination was also made of relative amounts of substances which stimulate the growth of yeast in sugar solutions and which affect the suitability of the sugar for use in the manufacture of beverages.

The data were obtained by the examination of a portion of the regular composite samples described in the preceding part of this report, and the same identification numbers have been used. The results are given in two sections: (1) Examination for microorganisms, and (2) examination for yeast-growth-promoting substances.

EXAMINATION FOR MICROORGANISMS

Methods and media used for the enumeration of thermophilic and mesophilic organisms and the standards adopted for these groups were given in the report for 1946 and will not be repeated here. No changes were made or proposed during the past year by sugar manufacturers or consumer interests of methods or standards for either group of microorganisms.

The results of the examination of the sugars for microorganisms are given in Table I.

Thermophilic Bacteria. Examination was made of the 83 samples of sugar submitted by 77 factories. Only two of the samples, or 2.4%, contained more than the permissible number of thermophilic bacteria permitted by the standards for canning grade sugar. These were samples Nos. 4734 and 4793 which contained 430 and 305 thermophilic aerobic spores, respectively, as compared with the permissible number of 125 spores per 10 grams of sugar. Sample No. 4793 also contained 165 flat sour spores per 10 grams of sugar as compared with the permitted number of 50. These values are well below the canning grade standards and are an improvement over those of the previous year when 7 samples, or 9.1%, contained excessive numbers of these organisms.

None of the samples contained more than three anaerobic sulfide spores or more than 66.6% of positive tubes for anaerobic hard swell types as compared with the standard of 5 spores per 10 grams of sugar and 66.6% of the tubes, respectively.

In comparing the overall quality of the sugars from the standpoint of canning grade specifications with those of previous years, it is noted that the 97.6% of samples passing this year is a higher percentage than that for any year since the beginning of this test in 1933. Two other years - 1943 and 1938 - were in the same range, with values of 95.4 and 96.1%, respectively. Most of the improvement this year is due to the elimination of flat sour type spores. Whereas the average number of spores in 1946 was 18.0, it was 4.7 per 10 grams this year.

Mesophilic Organisms. This group of organisms includes bacteria which grow at ordinary temperatures, yeast, and molds. The culture media which are used for their enumeration and incubation temperatures were given in last year's report. There were three samples, or 3.6%, which contained more than the suggested limit of 100 aerobic mesophilic bacteria per gram of sugar, as compared with four samples, or 5.2%, for the previous year. This improvement is further

TABLE I

BACTERIOLOGICAL EXAMINATION OF 1947 SUGARS

	THERMOPHILIC BACTERIA				MESOPHILIC ORGANISMS			
	Aerobes		Anaerobes		Aerobic Bacteria		Yeasts	Molds
Sample No.	Total Count Per 10 Gm.	Flat Sour Per 10 Gm.	Sulphide Spores Per 10 Gm.	Hard Swell % Tubes With Growth	Total Per 1.0 Gm.	Acid-Forming Per 1.0 Gm.	Total Per 1.0 Gm.	Number Colonies Per 1.0 Gm.
4702A	15	0	0	0	10	9	0	3
4702B	10	10	0	0	13	13	0	3
4703	10	10	0	0	17	5	0	1
4704	10	10	0	0	6	0	0	0
4705	0	0	0	0	4	1	0	1
4706A	5	0	0	0	30	27	0	1
4706B	15	0	0	0	10	10	0	9
4707	10	10	0	0	6	3	0	1
4708	5	0	0	0	8	3	0	0
4709	30	25	0	0	146	125	0	0
4710	20	0	0	66.7	23	10	0	1
4711	10	5	0	0	10	3	0	2
4712	5	0	0	0	10	1	0	1101
4713	5	0	0	0	1	1	0	0
4714	0	0	0	33.3	3	2	0	0
4715	20	20	0	0	5	3	0	0
4716	0	0	0	0	6	0	0	1
4717	0	0	0	0	3	3	0	17
4720	5	0	3	16.7	53	13	0	7
4721	60	0	0	0	2	1	0	6
4722	0	0	0	16.7	13	5	0	2
4724	0	0	0	0	4	2	0	2
4725	40	30	0	0	30	29	0	6
4726	5	0	0	0	7	2	0	0
4727	0	0	0	0	4	1	0	0
4728	0	0	0	0	28	20	0	0
4729	5	0	0	0	2	1	0	0

TABLE I - Continued

	THERMOPHILIC BACTERIA				MESOPHILIC ORGANISMS			
	Aerobes		Anaerobes		Aerobic Bacteria		Yeasts	Molds
Sample No.	Total Count Per 10 Gm.	Flat Sour Per 10 Gm.	Sulphide Spores Per 10 Gm.	Hard Swell % Tubes With Growth	Total Per 1.0 Gm.	Acid-Forming Per 1.0 Gm.	Total Per 1.0 Gm.	Number Colonies Per 1.0 Gm.
4730	0	0	0	0	2	1	0	0
4731	25	0	0	0	8	3	0	0
4732	40	0	0	0	1	0	0	1
4733	15	5	0	0	9	4	0	4
4734	430 (1)	1	0	0	12	11	0	0
4735	10	0	0	0	7	1	0	1
4737	25	10	0	0	6	2	1	4
4739	20	0	0	0	5	0	0	1
4740	20	0	0	0	7	3	0	2
4741	50	10	0	50	7	4	0	0
4742	40	0	0	0	5	0	1	0
4743	5	0	3	0	2	0	0	3
4744A	10	0	0	0	8	0	0	1
4744B	25	0	0	0	7	4	0	0
4745	5	0	0	0	7	2	0	9
4746	5	0	0	16.7	8	4	0	1
4747	20	5	0	0	3	1	0	0
4749	25	0	0	0	40	27	0	2
4750	45	0	0	0	9	3	0	2
4752	25	15	0	66.7	79	48	0	22
4753	25	0	0	0	5	4	0	0
4754	40	0	0	0	5	2	0	1
4755	55	0	0	0	13	0	0	0
4756A	0	0	0	0	6	0	0	0
4756B	20	0	0	0	33	28	0	2
4757	25	0	0	0	4	1	0	1
4758	60	0	0	0	31	26	0	7

TABLE I - Continued

	THERMOPHILIC BACTERIA				MESOPHILIC ORGANISMS			
	Aerobes		Anaerobes		Aerobic Bacteria		Yeasts	Molds
Sample No.	Total Count Per 10 Gm.	Flat Sour Per 10 Gm.	Sulphide Spores Per 10 Gm.	Hard Swell % Tubes With Growth	Total Per 1.0 Gm.	Acid-Forming Per 1.0 Gm.	Total Per 1.0 Gm.	Number Colonies Per 1.0 Gm.
4759	10	0	0	0	2	0	0	3
4760	35	0	0	0	8	8	0	2
4761	55	0	0	0	9	1	0	4
4762	20	0	0	0	3	2	0	3
4763	30	0	0	0	2	1	0	189
4764A	30	0	0	0	22	19	0	2
4765	70	0	0	0	11	7	0	5
4766	30	0	0	0	10	6	0	1
4768	25	0	0	0	10	2	2	4
4769	10	0	0	0	11	0	0	2
4771	25	5	0	0	10	1	0	59
4772	70	0	0	0	20	10	0	13
4773	55	0	0	0	14	1	0	17
4775	20	5	0	0	Impossible to count because of spreading (1)		0	4
4776	15	5	0	0	9	7	0	1
4777	45	15	0	0	50	40	0	5
4778	50	15	0	0	9	3	0	1
4779	0	0	0	0	24	3	0	5
4780	25	0	0	0	6	3	0	0
4782	30	0	0	0	12	8	0	2
4783	10	0	0	0	14	1	0	5
4784	30	0	0	0	8	5	0	13
4790	30	5	0	0	6	2	0	4
4791Beet	25	5	0	0	194	43	0	0
4791Cane	55	10	0	0	40	30	0	0
4691Beet(2)	20	0	0	0	25	18	0	96
4793	305	165	0	0	33	20	0	2

TABLE I - Continued

	THERMOPHILIC BACTERIA				MESOPHILIC ORGANISMS			
	Aerobes		Anaerobes		Aerobic Bacteria		Yeasts	Molds
Sample No.	Total Count Per 10 Gm.	Flat Sour Per 10 Gm.	Sulphide Spores Per 10 Gm.	Hard Swell % Tubes With Growth	Total Per 1.0 Gm.	Acid-Forming Per 1.0 Gm.	Total Per 1.0 Gm.	Number Colonies Per 1.0 Gm.
4794	15	0	0	16.7	49	15	0	6
4795	25	0	0	0	7	5	0	0

(1) Cultures repeated using 1-5 and 1-50 dilutions.

(2) Not included in last report.

reflected by a comparison of the average of 17 bacteria per gram this year with 40.1 in 1946. Yeasts were found in only two samples again this year and then only to the extent of 1 yeast per gram of sugar. This is insignificant as far as industrial use of the sugar is concerned - there would be no question regarding its use in beverages, sirups, dairy products, etc. Molds were found in excessive numbers in four samples and to such an extent that they were probably introduced into the sugar during its manufacture rather than from handling the composite sample. The suspect samples which contained penicillium in nearly pure culture are Nos. 4712, 4763, 4771 and 4791. Of the remaining samples 24 were found to be free of mold contamination and 24 to contain 5 molds or less per gram of sugar, some of which were undoubtedly introduced during handling of the composite sample rather than during the manufacture of the sugar.

EXAMINATION FOR YEAST-GROWTH-PROMOTING SUBSTANCES

Composite samples were again examined for the presence and relative amount of substances which promote the growth of yeasts in solution of the sugar. Sources of information regarding the identification of these substances, their significance in beverages, and methods for estimating and reporting the relative amount in each sample were given in the report issued last year.

Results for the examination of the samples for these substances are given in Table II, with samples arranged in numerical order of increasing yeast-inoculum multiple values. The yeast-inoculum multiple is obtained by dividing the number of yeast cells per ml. after 72 hours of incubation at 30° C. by the number introduced in the inoculum. The value 1.0 means that there was no multiplication of cells and that yeast-growth-promoting substances are considered to be absent when determined by this method.

The range of yeast-inoculum multiple values this year is from 1.0 to

TABLE II

RANKING OF SUGAR SAMPLES COLLECTED DURING 1947 CAMPAIGN ON BASIS OF RELATIVE FREEDOM FROM YEAST GROWTH-PROMOTING SUBSTANCES

Sample No.	Rank	Yeast-Inoculum Multiple
4706B	1	1.0
4727	1	1.0
4757	1	1.0
4761	1	1.0
4784	1	1.0
4750	2	1.2
4753	2	1.2
4759	2	1.2
4714	3	1.4
4722	3	1.4
4749	3	1.4
4791 Cane	4	1.6
4740	5	1.8
4790	5	1.8
4717	6	2.0
4724	7	2.5
4710	8	2.7
4782	8	2.7
4702B	9	2.9
4742	9	2.9
4778	9	2.9
4739	10	3.1
4708	11	3.3
4746	11	3.3
4711	12	3.5
4725	13	3.7
4737	13	3.7
4771	14	3.9
4732	15	4.1
4743	15	4.1
4721	16	4.3
4754	17	4.5
4720	18	4.7
4769	18	4.7
4733	19	4.9
4756B	19	4.9
4776	19	4.9
4706A	20	5.3
4745	20	5.3
4791B	21	5.5
4705	22	5.7
4744B	22	5.7
4783	22	5.7
4709	23	5.9
4707	24	6.1
4735	24	6.1
4765	25	6.3
4712	26	6.7
4702A	27	6.9
4715	27	6.9
4731	27	6.9
4704	28	7.1
4716	29	7.8
4777	30	8.0
4795	30	8.0
4741	31	8.4
4762	31	8.4
4766	31	8.4
4760	32	8.6
4763	33	9.0
4780	33	9.0
4703	34	9.2
4730	35	9.4
4764A(Spring)	35	9.4
4729	36	10.4
4728	37	10.6
4747	38	10.8
4772	39	11.0
4768	40	11.2
4726	41	11.4
4755	41	11.4
4773	41	11.4
4793	42	12.5
4756A	43	12.9
4713	44	13.1
4794	44	13.1
4752	45	14.1
4734	46	14.3
4775	46	14.3
4691B(1)	47	14.9
4779	48	15.5
4758	49	17.1
4744A	50	21.8

(1) Not included in last report.

21.8, with an average of 6.6, as compared with a range of 1.0 to 30.3 and an average of 6.9 for 1946. Again this year all of the samples are considered to be well within the safe limit for use in the manufacture of beverages, sirups, and other products in which yeast growth might be a limiting factor in their keeping quality.

LW:LG